AMENDMENT NO. 1 JUNE 2021

TO

IS 15490 : 2017 SEAMLESS STEEL CYLINDERS FOR ON-BOARD STORAGE OF COMPRESSED NATURAL GAS AS A FUEL FOR AUTOMOTIVE VEHICLES — SPECIFICATION

(First Revision)

(*Second cover page*, *foreword*, *para* 2, *last sentence*) — Substitute the following for the existing :

'However, considering the prevailing practices of cylinder manufacturing in the country, changes have been made wherever necessary.'

(*Second cover page*, *foreword*, *para* 4, *last sentence*) — Delete.

(*Second cover page*, *foreword*, *para* 4) — Insert the following new para after para 4:

'Normalized seamless steel cylinders are covered in IS 7285 (Part 1) : 2018 Refillable seamless steel gas cylinders — Specification : Part 1 Normalized steel cylinders. Quenched and tempered steel cylinders are covered in IS 7285 (Part 2) : 2017 Refillable seamless steel gas cylinders — Specification : Part 2 Quenched and tempered steel cylinders with tensile strength less than 1 100 MPa (112 kgf/mm^2)'.

(*Second cover page*, *foreword*, *para* 5, *line* 1) — Substitute 'IS 8451 : 2018 Periodic inspection and testing of seamless steel gas cylinders — Code of practice' *for* 'IS 8541 : 2009 Periodic inspection and testing of high pressure gas cylinders – Code of practice'.

(*Page* 1, *clause* **2**) — Insert the following at the end:

IS No.	*Title*
15958 : 2012	Compressed natural gas (CNG) for automotive purposes — Specification

Price Group 3

(*Page* 2, *clause* **3.2.3.1**) — Substitute the following for the existing:

'**3.2.3.1** *General* — Methanol and/or glycol shall not be deliberately added to the natural gas. Cylinders shall be designed suitable for filling with natural gas conforming to IS 15958.'

(*Page* 2, *clause* **3.6**) — Substitute the following for the existing:

'**3.6 Tempering** — Toughening heat treatment which follows quenching, in which the cylinder is heated to a uniform temperature below the lower critical point, AC_1, of the steel.'

(*Page* 2, *clause* **3.7**, *title*) — Substitute 'Yield Strength (R_{eg})' *for* 'Yield Stress (R_e)' and wherever it appears in the standard.

(*Page* 2, *clause* **3.8**) — Substitute the following for the existing:

'**3.8 Batch** — A quantity of up to 200 cylinders plus cylinders for destructive testing of the same nominal diameter, thickness and design, made successively from the same heat number of steel and subjected to the same heat treatment for the same duration of time.'

(*Page* 3, *clause* **4**, *symbol* r) — Insert the following symbol below '*r*':

'R_{ea} = actual value of the yield strength, in MPa, as determined by the tensile test;'

(*Page* 3, *clause* **4**, *symbol* R_g) — Substitute 'R_{mg}' *for* 'R_g' and wherever it appears in the standard.

(*Page* 3, *clause* **4**, *symbol* R_m) — Substitute 'R_{ma}' *for* 'R_m' and wherever it appears in the standard.

(*Page* 3, *Table* 1) — Substitute the following for the existing:

Table 1 Chemical Composition Tolerances

(*Clauses* 5.2.1 *and* 5.3)

Sl No.	**Element**	**Maximum Content (Mass Fraction)** Percent	**Maximum Permissible Deviations (Mass Fraction)** Percent	**Maximum Permissible Range (Mass Fraction)** Percent
(1)	(2)	(3)	(4)	(5)
i)	Carbon	< 0.30 ≥ 0.30	0.06 0.07	0.06 0.07
ii)	Manganese	All values	0.30	0.30
iii)	Silicon	All values	0.30	0.30
iv)	Chromium	< 1.50 ≥ 1.50	0.30 0.50	0.30 0.50
v)	Nickel	All values	0.40	0.40
vi)	Molybdenum	All values	0.15	0.15

(*Page* 4, *Table* 2) — Substitute the following for the existing:

Table 2 Maximum Sulphur and Phosphorus Limits (mass fraction) in Percentage

(*Clause* 5.2.2)

Sl. No.	**Element**	**Maximum Content Limits (Mass Fraction)** Percent
(1)	(2)	(3)
i)	Sulphur	0.010
ii)	Phosphorus	0.020
iii)	Sulphur + Phosphorus	0.025

(*Page* 4, *Table* 3) — Substitute the following for the existing:

Table 3 Internationally Recognized Steel Compositions (Cast Analyses) (Mass Fraction)

(*Clause* 5.4)

Sl No.	Element	Steel Grade and Conditions (Mass Fraction) (Percent) for Cr Mo (Q and T)	for C Mn (Q and T)
(1)	(2)	(3)	(4)
i)	Carbon	0.250 - 0.380	0.380, *Max*
ii)	Silicon	0.100 - 0.400	0.100 - 0.350
iii)	Manganese	0.400 - 1.000	1.350 - 1.700
iv)	Phosphorus	0.020, *Max*	0.020, *Max*
v)	Sulphur	0.010, *Max*	0.010, *Max*
vi)	Chromium	0.800 - 1.200	—
vii)	Molybdenum	0.150 - 0.400	—

(*Page* 4, *clause* **5.5**) — Substitute the following for the existing:

'**5.5** Suitable steels other than above may be used with the prior permission of the statutory authority. In such a case, the yield strength and tensile strength of the steel taken for the purpose of calculating the wall thickness of the cylinder shall not be greater than the minimum values specified by the steel manufacturer.'

(*Page* 4, *clause* **6.1.1**) — Substitute the following for the existing:

'**6.1.1** The calculation of the wall thickness of the pressure containing parts shall be related to the guaranteed minimum yield strength (R_{eg}) of the material in the finished cylinder.'

(*Page* 4, *clause* **6.1.2**) — Substitute the following for the existing:

'**6.1.2** For calculation purposes, the value of R_{eg} shall not exceed 0.90 R_{mg}.'

(*Page* 4, *clause* **6.1.3**) — Insert the following sentence at the end:

'P_h is hydrostatic test pressure above atmospheric (1.5 times the working pressure).'

(*Page* 4, *clause* **6.1.3**) — Insert the following new clause:

‘**6.1.4** Cylinders may be designed with one or two openings along the central cylinder axis only.’

(*Page* 4, *clause* **6.2.1**) — Substitute the following for the existing:

‘**6.2.1** *Calculation of Cylindrical Shell Thickness*

6.2.1.1 The guaranteed minimum wall thickness of the cylindrical shell of the cylinder to be calculated using Equations (1) and (2), and additionally condition (3) shall be satisfied.

$$a = \frac{D_o}{2} \times \left(1 - \sqrt{\frac{10F \times R_{eg} - \sqrt{3}P_h}{10F \times R_{eg}}} \right) \qquad \ldots (1)$$

where the value of F is the lesser of 0.65 / (R_{eg}/R_{mg}) or 0.85 and F is design stress factor (variable)

R_{eg}/R_{mg} shall not exceed 0.90.

The wall thickness shall also satisfy equation (2)

$$a \geq D_o / 250 + 1 \qquad \ldots (2)$$

with an absolute minimum of $a = 1.5$ mm

The burst ratio shall be satisfied by test as given in equation (3)

$$P_b / P_h \geq 1.6 \qquad \ldots (3)$$

NOTES

1 It is generally assumed that $P_h = 1.5$ times working pressure for compressed gases for cylinders designed and manufactured to conform to this standard.

2 R_{eg} and R_{mg} shall be in MPa, Diameter in mm and P_h in bar.’

(*Page* 5, *clause* **6.2.2**) — Delete.

(*Page* 5, *clause* **6.3.1**) — Substitute the following for the existing:

‘The thickness, *b*, at the center of a convex end shall be not less than that required by the following criteria:

$b \geq 1.5\acute{a}$ for $H/D_o \geq 0.25$

$b \geq 2a'$ *for* $0.25 > H/D_o \geq 0.2$

where the inside knuckle radius, *r*, is not less than 0.075 D_o.

NOTE — $H/D_o < 0.20$ is not recommended.'

(*Page* 5, *clause* **6.3.1.1**) — Substitute the following for the existing:

'**6.3.1.1** For cylinders manufactured from plate, the thickness, *b*, at the centre of a convex end shall be not less than that required by the following criteria:

$$b \geq 1.5\text{á}\ for\ 0.40 > H / D_o \geq 0.20$$

$$b \geq \text{á}\ for\ H / D_o \geq 0.40$$

where the inside knuckle radius, *r* is not less than 0.075 D_o.

NOTE — $H/D_o < 0.20$ is not recommended.'

(*Page* 5, *clause* **6.3.2**) — Delete.

(*Page* 5, *clause* **6.4**) — Delete.

(*Page* 5, *clause* **6.4.1**) — Substitute the following for the existing:

'**6.4.1** The cylinder manufacturer shall in any case prove by pressure cycling test as given in **9.2.3** that the design is satisfactory.'

(*Page* 7, *Fig.* 2) — Delete.

(*Page* 8, *Fig.* 3) — Delete.

[*Page* 9, *clause* **9.1** j)] — Substitute the following for the existing:

'j) guaranteed minimum yield strength (R_{eg}) and/or the guaranteed minimum tensile strength (R_{mg}) for the finished cylinder have changed; or'

(*Page* 10, *clause* **9.2.3**, *para* 2) — Substitute the following for the existing:

'The value of the lower cycling pressure shall not exceed 10 percent of the upper cyclic pressure, but shall have an absolute maximum of 30 bar.'

(*Page* 10, *clause* **9.2.4**) — Substitute the following for the existing:

'**9.2.4** The actual burst pressure shall be not less than 48 MPa (480 bar).'

(*Page* 11, *Table* 4) — Substitute the following for the existing:

Table 4 Change of Design

(*Clause* 9.2.8)

Sl No.	Design Change	Type of Test			
		Hydraulic Bursting (*see* **9.2.3**)	Pressure Cyclic at ambient Temperature (*see* **9.2.3**)	Leak Before Break (*see* **9.2.6**)	Bonfire (*see* **9.2.7**)
(1)	(2)	(3)	(4)	(5)	(6)
i)	Diameter change ≤ 20 percent	x	x	—	—
ii)	Diameter change > 20 percent	x	x	x	x
iii)	Length change ≤ 50 percent	x	—	—	x[1]
iv)	Length change > 50 percent	x	x	—	x[1]
v)	Working pressure change ≤ 20 percent[2]	x	x	—	—
vi)	Dome shape	x	x	—	—
vii)	Opening size	x	x	—	—
viii)	Change in manufacturing process	x	x	—	—
ix)	Pressure relief device	—	—	—	x

[1] Test only required when length increases.

[2] Only when thickness change proportional to diameter and / or pressure change.

(*Page* 12, *clause* **9.3.1**, *fourth sentence*) — Substitute the following for the existing:

'The tensile strength, yield strength shall not be less than minimum specified in design drawing and percentage elongation measured shall not be less than 14 percent.'

(*Page* 12, *Table* 5) — Substitute the following for the existing:

Table 5 Bend Test Requirements

(*Clause* 9.3.2)

Sl No.	**Actual Tensile Strength, R_m (in MPa)**	**Value of *n***
(1)	(2)	(3)
i)	Upto and including 800	4
ii)	Above 800 upto and including 880	5
iii)	Above 880 upto and including 950	6
iv)	Above 950 upto and less than 1 100	7

(*Page* 12, *Table* 6) — Substitute the following for the existing:

Table 6 Impact Test Acceptance Values

(*Clauses* 9.3.3 *and* 9.3.3.1)

Sl. No.	**Cylinder Diameter D_o, in mm**		**> 140**			**≤ 140**
(1)	(2)		(3)			(4)
i)	Direction of testing		Transverse			Longitudinal
ii)	Width of the test piece		3 - 5	> 5 - 7.5	>7.5 - 10	3 - 10
iii)	Test temperature, in °C[1)]		-20			-20
iv)	Impact strength[2)] in J/cm^2, *Min*	Mean of 3 specimens	30	35	40	60
		Individual specimen	24	28	32	48

[1)] For applications at lower temperatures the test shall be carried out at the lowest temperature specified.

[2)] The impact value J/cm^2 is calculated by dividing the impact energy (J) by the actual cross-sectional area below the notch (cm^2) of the Charpy test specimen.

(*Page* 15, *clause* **11.4**) — Substitute the following for the existing:

‘11.4 Leakage Test

Cylinders which have been closed at the end by forging or spinning, and which have passed the hydrostatic stretch test shall be subjected to a pneumatic pressure not less than two third of the hydrostatic test pressure, and shall thereupon show no signs of leak.’

(*Page* 16, *clause* **15**) — Substitute the following for the existing:

‘15 Colour Identification

15.1 The cylinder shall be painted or powder coated externally in accordance with the colour scheme specified in IS 4379 or as specified by statutory authority.

15.2 The external surface of cylinder shall be painted or powder coated.

15.2.1 For painting use the following paint system and total minimum dry film thickness of 70µ shall be maintained:

a) Epoxy Primer (two component system) 1 coat — Zinc Phosphate / Zinc Chromate / Zinc Rich; and

b) Epoxy / Polyurethane (two component system) 1 coat

15.2.2 For powder coating use the coating system with final coat of powder and final minimum coating thickness of 70µ.

15.3 Cylinder manufactured for export shall be painted or powder coated externally as agreed to between the purchaser and the manufacturer.’

(MED 16)

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